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MARKET PREPACKAGING TESTS WITH PEACHES

By

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Report of a study made under
the Research and Marketing Act of 1946
(RM-44)

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This is a report on two prepackaging tests with peaches conducted during the summer of 1947, and two conducted during the summer of 1948, at the U. S. Market Pathology Laboratory at New York City under the general supervision of James S. Wiant. The work was part of a Research and Marketing project entitled "Quality Preservation in Prepackaged Fruits and Vegetables." Films for testing were supplied by the Celanese Plastics Corporation and E. I. duPont deNemours and Company.

The first test was initiated on September 16, with fruit grown in Pennsylvania; the second test on September 23, with fruit grown in Michigan. The third test was begun on August 23, (1948) and the fourth on August 31, with Virginia and Pennsylvania fruit respectively. Elberta peaches purchased on the New York market were used in all four tests. Decayed or bruised peaches and the fully ripe and greener fruit were discarded. The sound fruit, chiefly firm, but ranging from hard to firm ripe, were divided uniformly into the several lots and packaged six 1/

1/ Five to the tray in tests 3 and 4.

to the tray, in open chipboard trays of two-pound capacity, overwrapped with sheets of film.

Tests 1 and 2

Films used in the first two tests were (1) moisture-proof cellophane (300 MSAT 86); (2) MSAT as in (1), except that the film in each package was perforated with two holes, 3/16" in diameter; (3) semi-moisture-proof cellophane (300 LSAT); and (4) cellulose acetate (100 CA). Unwrapped trays constituted a fifth lot. Both cellophane films were heat sealed; the cellulose acetate was solvent sealed. In each test four replicate packages of each of the five lots were weighed and placed at 45° F., and four at 65° F. Those at 45° were removed after six days. In test No. 1 half of those at 65° were removed after two days and half after three days; in test No. 2 all at 65° were removed after three days.

At the time of removal from the storage rooms, all packages were again weighed and observations made on appearance of film, on presence of decay and on appearance and flavor of the fruit. Determinations of carbon dioxide in the atmosphere within the closed containers were made in both tests.

The results of the tests are summarized in Table 1. It will be noted

Table 1. - Summary of observations on prepackaged peaches, tests 1 and 2. 1947.

that the fruit in the packages overwrapped with either non-perforated MSAT or non-perforated LSAT developed abnormal flavors both at 65° and 45° F. The peaches in these packages may be described as having a slightly fermented or "winey" flavor and odor, due to the cumulative effect of suboxidation. Carbon dioxide concentrations were much higher in the packages overwrapped with MSAT than in those overwrapped with LSAT, particularly in the 65° lots. In the LSAT lots at 45° no abnormal flavors were noted in test No. 2, where carbon dioxide concentrations ranged from 4 to 6 per cent, while in test No. 1 where carbon dioxide concentrations of 8 to 11 per cent were found, the flavor was impaired in only two of the four packages. The flavor of peaches overwrapped with perforated MSAT and with CA was normal and similar to that of the unwrapped check fruit.

Weight loss was greatest in the unwrapped lots - over 8 percent at two of the three inspections of test No. 1. This was reflected in the slightly shriveled and therefore slightly less attractive appearance of the peaches in the check lot. Next largest weight loss occurred in the packages overwrapped with CA, which lost approximately half as much weight as did the checks. Weight loss was negligible in the LSAT and the MSAT (both non-perforated and perforated lots.

Loss from decay was high throughout both tests, regardless of film used. Ninety per cent of all decay was brown rot; the remainder was rhizopus rot. In view of the fact that consumers would not knowingly purchase a package where even a single peach showed evidence of decay, any such packages should be considered as unsalable. Considering all sixteen replicates of each film lot, decay was found in thirteen packages or 81 per cent of both check and CA lots respectively, ten packages or 63 per cent of the LSAT lot, twelve packages or 75 per cent of the MSAT perforated lot, and seven packages or 44 per cent of the MSAT non-perforated lot. Consequently few packages of any type were salable at the time of inspection.

Test 3

The third test consisted of comparisons of cellulose acetate (100 CA) and perforated moisture-proof cellophane (300 MSAT 86) at the four temperatures 32°, 50°, 65° and 90° F. 2/ Six packages of each film, and the check

2/ Room temperature ranging from 70° - 90° F.

were placed at each temperature so that two replicates could be removed daily on the three following days. 3/ After opening the packages and

3/ At 32° two packages were removed after one day and one each after two and three days and two after seven days. Only those packages examined the first three days are included in the data of Table 3.

inspecting the fruit, all peaches remaining were held at prevailing room temperatures (83°) in order to determine the time required for ripening to good eating condition. The results of the test are summarized in tables 2 and 3.

Table 3. - Summary of observations on prepackaged peaches, test 3. 1948.
Table 3. - Ibid (continued)

One of the most interesting results was that suboxidation flavors were found in some of the packages overwrapped with CA. In no instance was this found in lots stored at 32°. Although data on flavor are not shown in the tables there were no abnormal flavors noted in fruit stored at 50° (either for 1, 2 or 3 days), however, in both packages examined after three days' storage, the fruit had a very slight odor of fermentation. At 65° there were markedly abnormal odors and flavors of suboxidation, evident in both packages examined on the first and the second day and in one package of the third day. A carbon dioxide concentration of 10.2 per cent was found in the latter. Slight abnormal odors were noted at both the second and third day inspections at 83° and abnormal flavors were noted in a single package at the third day inspection. A carbon dioxide concentration of 10.4 per cent was found in this package.

Greatest weight loss occurred in the unwrapped lots and least in the packages overwrapped with perforated MSAT. Weight loss was highest at the highest temperature (83°), particularly in the packages held two and three days, where slight shriveling was evident in the unwrapped packages.

From the data in table 3 it will be seen that during the first three days of the test while the fruit was in storage decay occurred in 11 of the 66 packages. When decay that appeared during ripening at room temperature is also considered, 22 of the 66 packages were affected. Practically all of the decay was brown rot. Thus, although decay was serious it was less prevalent than in tests 1 and 2. It should be noted in this connection that the fruit used for test 3 showed less than one per cent decay at the time of purchase, whereas that for tests 1 and 2 showed eight per cent and five per cent respectively.

The relation of temperature, type of film, and length of storage to development of decay in the present test can be seen from the data in table 3.

At the time of removal there was no decay in any of the 32° packages; decay was noted at the three higher temperatures and was progressively worse with rise in holding temperatures. However, by the time the peaches had ripened, decay had developed to a considerable extent in the lots from all four temperatures (7.8 to 10 per cent). From the last column in table 3 it can be seen that if all packages had been held until the peaches were ripe, over one-third would have contained decaying peaches.

There was somewhat less decay in the check (unwrapped) lots than in those packages overwrapped with either CA or MSAT. During the short period of the tests, there was little difference in decay of the various lots held at the different temperatures. Slightly more decay was found in those held for 3 days than in the other lots.

The only advantage of holding the prepackaged peaches at the two lowest temperatures (32° and 50°) was to prolong the marketing period. Those in overwrapped packages held at 32° (footnote 3 of table 2) were still in good condition after seven days and required one day at room temperature before ripening. Lots held for three days at 83° were still not overripe. However, unwrapped peaches held at 83° for two days lost nearly 8 per cent of their weight and were not as fresh in appearance as similar lots that were overwrapped; heavy weight loss (9.6 per cent) occurred in those held three days and the fruits were slightly wilted. With the exception of these two lots and the lot wrapped in CA, and held three days at 83°, where six per cent weight loss occurred and where a slight impairment of freshness was noted, all lots referred to in table 2 were of good fresh appearance at time of removal from the holding rooms. Those lots which required further ripening were still fresh at the end of the ripening period.

Test 4

The fourth test was set up to further investigate the question of suboxidation in packages wrapped with cellulose acetate film. In view of the fact that cellulose acetate film from two different sources was used, they are here designated as follows: CA #1, obtained in 1946, was used in tests 1 and 2; CA #2, obtained from a different manufacturer in July, 1948, was used in test 3.

The behavior of both non-perforated CA #1 and CA #2 was compared with non-perforated MSAT 86 and with CA #2 film which was perforated with two 3/16 inch holes per package. Unwrapped trays served as checks. Six replicate packages of each of the five lots were placed at 50° and six were placed at 83°F. (the prevailing room temperature). Two replicates were removed and examined daily on each of the three following days. Determinations of carbon dioxide and oxygen concentrations of the atmosphere within the packages were made at time of removal. Inspections for evidences of suboxidation by odor and flavor were also made at this time. The results of the test are summarized in table 4.

Table 4. - Summary of observations on prepackaged peaches, Test 4, 1948.

It will be noted that evidences of suboxidation (indicated by abnormal odors, flavors, or both) were found at the 83° temperature in all six replicates of the packages overwrapped with non-perforated MSAT and all six replicates overwrapped with non-perforated CA #2. A single package overwrapped with CA #1 likewise showed evidence of suboxidation. The fruit in the other 83° packages had normal flavor and odor. No abnormal odors or flavors indicative of suboxidation were detected in any of the peaches held at 50°. It should be pointed out that the odors and flavors of suboxidation were evident in the 83° lots of CA #2 and MSAT after the one day holding period and they increased in intensity upon holding for two and three days.

It will be noted from the data in table 4 that marked reduction in the oxygen content and marked increase in the carbon dioxide concentration was found within the packages, where peaches showed abnormal odors and flavors. This was particularly true in the MSAT packages. Packages at 50°, wrapped with all three types of film, showed no evidence of abnormal odors or flavors.

Discussion and Commercial Applications of the Results

Both semi-moisture proof cellophane (LSAT) and moisture proof cellophane (MSAT) when sealed tightly without perforations are completely unsuitable for peaches. When so enclosed the fruit developed a "winey" odor and flavor as a result of suboxidation. This occurred at temperatures as low as 45°F. Cellophane when perforated 4/ to allow for normal exchange of gases, had

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4/ Perforated MSAT tested.

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no effect on flavor or aroma and at the same time protected the fruit from moisture loss.

The results with cellulose acetate were variable. In some instances there was no injurious effect from tight enclosure within this film. At other times there were definite injurious effects as evidenced by presence of abnormal odors and flavors characteristic of suboxidation. Equally striking were the marked reductions in oxygen content and the increases in carbon dioxide content of the atmosphere within packages tightly sealed with cellulose acetate. This is best seen from the figures given in table 4. The extent or degree of suboxidation was not as great with non-perforated cellulose acetate as with non-perforated cellophane.

The high amount of decay that occurred in the present tests indicates that under some conditions market prepackaging of peaches may not be successful - particularly when brown rot is prevalent. The presence of a single decayed fruit in a package would of course require either repackaging or sale at discount. Holding the fruit at lower temperatures after prepackaging retards the appearance of decay. However, after removal from low temperature the peaches decay as badly during ripening as those held constantly at higher temperatures (table 3). Therefore, for market prepackaging, peaches should preferably be selected from lots as free of decay as possible, packaged after they are nearly ripe enough for consumption, then moved promptly through trade channels. It would appear advisable to perforate all films.

TABLE 1
SUMMARY OF OBSERVATIONS ON PREPACKAGED PEACHES, TESTS 1 AND 2, 1947.

		At 65° - 2 days					At 65° - 3 days					At 45° - 6 days				
				Decay					Decay					Decay		
Film	Test No.	Wgt. Loss %	Carbon Dioxide %	Packages Affected %	Fruit Affected Average of all Packages %	Flavor	Wgt. Loss %	Carbon Dioxide %	Packages Affected %	Fruit Affected Average of all Packages %	Flavor	Wgt. Loss %	Carbon Dioxide %	Packages Affected %	Fruit Affected Average of all Packages %	Flavor
MSAT	1	Trace	26, 22	0	0	Abnormal	0.4	31, 25	0	0	Abnormal	0.4	13, 12, 23, 16	50	12.5	Abnormal
MSAT	2	-	-	-	-	-	.0	17, 30, 23, 28	75	16.7	Abnormal	Trace	14, 8, 19, 13	50	16.7	Abnormal
MSAT-Perforated	1	0.2	1, 1	100	33.4	Normal	0.7	1, 1	100	41.7	Normal	0.5	0	50	25.0	Normal
MSAT-Perforated	2	-	-	-	-	-	0.1	1, 1, 1, 1	100	41.7	Normal	.0	0	50	12.5	Normal
LSAT	1	0.6	13, 11	50	8.3	Abnormal	1.0	12, 12	50	16.7	Abnormal	1.2	9, 10, 8, 11	50	12.5	Abnormal
LSAT	2	-	-	-	-	-	0.4	6, 10, 9, 12	75	25.0	Abnormal	0.2	5, 4, 6, 6	75	25.0	Normal
CA #1 1/	1	2.0	2, 3	100	16.7	Normal	3.2	3, 3	100	41.7	Normal	5.0	1, 2, 3, 3	75	29.2	Normal
CA #1 1/	2	-	-	-	-	-	1.8	1, 1, 4, 2	75	16.7	Normal	2.3	1, 1, 2, 1	75	20.8	Normal
Check-Unwrapped	1	4.8	-	50	16.7	Normal	8.7	-	100	58.3	Normal	8.3	-	100	33.3	Normal
Check-Unwrapped	2	-	-	-	-	-	3.8	-	100	37.5	Normal	4.2	-	50	12.5	Normal

1/ Received from manufacturer A in 1946.

TABLE 2
SUMMARY OF OBSERVATIONS ON PREPACKAGED PEACHES, TEST 3, 1948.

		Held One Day					Held Two Days					Held Three Days 3/				
Film	Holding temperature	Wgt. Loss %	Ripeness at time of Removal 2/	Decay at time of Removal %	Days to Ripen at 83°	Decay Developed During Ripening %	Wgt. Loss %	Ripeness at time of Removal 2/	Decay At Time of Removal %	Days To Ripen at 83°	Decay Developed During Ripening %	Wgt. Loss %	Ripeness at time of Removal 2/	Decay At Time of Removal %	Days To Ripen at 83°	Decay Developed During Ripening %
CA #2 1/	32°	0.6	H-FR	0	2	12.5	1.0	H-F	0	2	25.0	1.4	H-FR	0	1	0
	50°	1.0	F-FR	0	2	0	1.4	H-FR	10.0	2	16.5	1.8	F-FR	0	1	12.5
	65°	1.0	H-FR	10.0	1 to 2	75.0	1.4	F-R	0	0	0	1.8	FR-R	20	0	0
	83°	2.0	F-R	0	1	0	3.6	F-FR	0	0	0	6.0	FR-R	10	0	0
MSAT 4/	32°	0.1	H-FR	0	1 to 2	10.0	0.1	H-FR	0	2	0	0.2	H-FR	0	1	0
	50°	0.2	H-FR	0	2	20.0	0.3	H-FR	0	2	10.0	0.2	H-FR	0	1	10.0
	65°	0.2	H-R	0	0 to 1	0	0.2	F-FR	0	0-1	0	0.4	F-R	0	0	0
	83°	0.2	F-R	30.0	0	0	0.5	F-R	10.0	0	0	0.8	FR-R	0	0	0
Checks	32°	1.5	H-FR	0	2 to 3	10.0	2.0	H-FR	0	2	0	2.4	H-FR	0	1	20.0
	50°	1.8	H-FR	0	2	0	2.4	H-FR	0	2	0	3.1	F-FR	0	1	0
	65°	1.5	H-R	0	1	0	2.6	F-R	0	0-1	0	4.0	FR-R	10	0	0
	83°	3.6	FR-R	0	0	0	7.8	F-R	0	0	0	9.6	FR-R	20	0	0

1/ Received from manufacturer B in July, 1948.
2/ H = hard, F = firm, FR = firm ripe, R = ripe.
3/ The following data were taken on the 2 packages of each film type held 7 days at 32° :

	CA	MSAT	Check
Weight loss - percent.....	2.3	0.3	5.1
Ripeness.....	F-FR	F-FR	H-F
Decay at removal - %	0	10	0
Days to ripen at 83° F.	1	1	1
Decay - developed during ripening..	0	0	0

4/ Perforated

TABLE 3
SUMMARY OF OBSERVATIONS ON PREPACKAGED PEACHES, TEST 3, 1948. (CONTINUED)

Temperature	Total Packages Number	Decay (% of Fruit Affected)		Packages Affected With Decay			
		At Removal	Total After Ripening	At Removal		Total After Ripening	
				Number	%	Number	%
32°	12	0	8.3	0	0	5	42
50°	18	1.1	7.8	1	5.6	6	33
65°	18	4.4	10.0	4	22.3	5	31
83°	18	7.8	7.8	6	33.3	6	33
Film							
CA #2	22	4.5	12.7	5	22.7	9	41
MSAT	22	3.6	8.2	3	13.6	8	36
Check	22	2.7	4.5	3	13.6	5	23
Length of Holding							
One Day	24	3.3	11.7	3	12.5	9	38
Two Days	21	1.9	4.8	2	9.5	4	19
Three Days	21	5.7	8.6	6	28.6	9	43

TABLE 4
SUMMARY OF OBSERVATIONS ON PREPACKAGED PEACHES, TEST 4, 1948.

Film	Temperature	Held One Day: Carbon Dioxide Concentration %	Held One Day: Oxygen Concentration %	Held One Day: Evidence of Suboxidation By Odor	Held One Day: Evidence of Suboxidation By Flavor	Held Two Days: Carbon Dioxide Concentration %	Held Two Days: Oxygen Concentration %	Held Two Days: Evidence of Suboxidation By Odor	Held Two Days: Evidence of Suboxidation By Flavor	Held Three Days: Carbon Dioxide Concentration %	Held Three Days: Oxygen Concentration %	Held Three Days: Evidence of Suboxidation By Odor	Held Three Days: Evidence of Suboxidation By Flavor
CA #1 1/	50°	3.8	–	No	No	5.0	13.6	No	No	1.0	18.5	No	No
		2.0	–	No	No	3.5	–	No	No	5.0	13.0	No	No
"	83°	8.2	4.6	No	No	9.0	7.0	Slight	Slight	6.4	12.6	No	No
		6.0	12.0	No	No	8.4	8.6	No	No	5.8	13.2	No	No
CA #2 2/	50°	2.6	–	No	No	–	–	No	No	2.0	17.0	No	No
		2.8	–	No	No	5.0	14.0	No	No	4.0	15.0	No	No
"	83°	9.2	2.8	Very Slight	No	7.0	7.5	Slight	Slight	7.0	6.4	Moderate	Trace
		9.8	2.4	" "	Trace	6.4	9.2	"	Normal	8.4	4.0	Moderate	Moderate
CA #2 - 2/ Perforated	50°	0	–	No	No	–	–	No	No	–	–	No	No
		–	–	No	No	–	–	No	No	–	–	No	No
"	83°	0.6	–	No	No	0.6	–	No	No	1.0	–	No	No
		0	–	No	No	–	–	No	No	–	–	No	No
MSAT 3/	50°	6.4	–	No	No	11.0	8.2	No	No	7.0	13.0	No	No
		8.0	–	No	No	12.0	8.0	No	No	13.0	7.0	No	No
"	83°	34.2	1.8	Very Slight	Moderate	38.4	4.0	Moderate	Moderate	58.0	7.0	Strong	Strong
		28.2	5.2	" "	"	43.4	2.8	"	"	71.0	0.5	"	"
Check-Unwrapped	50°	–	–	No	No	–	–	No	No	–	–	No	No
		–	–	No	No	–	–	No	No	–	–	No	No
"	83°	–	–	No	No	–	–	No	No	–	–	No	No
		–	–	No	No	–	–	No	No	–	–	No	No

1/ CA #1 obtained from manufacturer A in February, 1946.
2/ CA #2 obtained from manufacturer B in July, 1948.
3/ 300 MSAT 86.